



Books & Reports

GIS Methodology for Planning Planetary-Rover Operations

A document describes a methodology for utilizing image data downlinked from cameras aboard a robotic ground vehicle (rover) on a remote planet for analyzing and planning operations of the vehicle and of any associated spacecraft. Traditionally, the cataloging and presentation of large numbers of down-linked planetary-exploration images have been done by use of two organizational methods: temporal organization and correlation between activity plans and images. In contrast, the present methodology involves spatial indexing of image data by use of the computational discipline of geographic information systems (GIS), which has been maturing in terrestrial applications for decades, but, until now, has not been widely used in support of exploration of remote planets. The use of GIS to catalog data products for analysis is intended to increase efficiency and effectiveness in planning rover operations, just as GIS has proven to be a source of powerful computational tools in such terrestrial endeavors as law enforcement, military strategic planning, surveying, political science, and epidemiology. The use of GIS also satisfies the need for a map-based user interface that is intuitive to rover-activity planners, many of whom are deeply familiar with maps and know how to use them effectively in field geology.

This work was done by Mark Powell, Jeffrey Norris, Jason Fox, Kenneth Rabe, and I-Hsiang Shu of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-41178.

Optimal Calibration of the Spitzer Space Telescope

A document discusses the focal-plane calibration of the Spitzer Space Telescope by use of the instrument pointing frame (IPF) Kalman filter, which was described in "Kalman Filter for Calibrating a Telescope Focal Plane" (NPO-40798),

NASA Tech Briefs, Vol. 30, No. 9 (September 2006), page 62. To recapitulate: In the IPF Kalman filter, optimal estimates of both engineering and scientific focal-plane parameters are obtained simultaneously, using data taken in each focal-plane survey activity. The IPF Kalman filter offers greater efficiency and economy, relative to prior calibration practice in which scientific and engineering parameters were estimated by separate teams of scientists and engineers and iterated upon each other. In the Spitzer Space Telescope application, the IPF Kalman filter was used to calibrate 56 frames for precise telescope pointing, estimate >1,500 parameters associated with focal-plane mapping, and process calibration runs involving as many as 1,338 scientific image centroids. The final typical survey calibration accuracy was found to be 0.09 arc second. The use of the IPF Kalman filter enabled a team of only four analysts to complete the calibration processing in three months. An unanticipated benefit afforded by the IPF Kalman filter was the ability to monitor health and diagnose performance of the entire end-to-end telescope-pointing system.

This work was done by David Bayard, Bryan Kang, Paul Brugarolas, and Dhemetrio Boussalis of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-41178.

Automated Detection of Events of Scientific Interest

A report presents a slightly different perspective of the subject matter of "Fusing Symbolic and Numerical Diagnostic Computations" (NPO-42512), which appears elsewhere in this issue of *NASA Tech Briefs*. Briefly, the subject matter is the X-2000 Anomaly Detection Language, which is a developmental computing language for fusing two diagnostic computer programs — one implementing a numerical analysis method, the other implementing a symbolic analysis method — into a unified event-based decision analysis software

system for real-time detection of events. In the case of the cited companion *NASA Tech Briefs* article, the contemplated events that one seeks to detect would be primarily failures or other changes that could adversely affect the safety or success of a spacecraft mission. In the case of the instant report, the events to be detected could also include natural phenomena that could be of scientific interest. Hence, the use of X-2000 Anomaly Detection Language could contribute to a capability for automated, coordinated use of multiple sensors and sensor-output-data-processing hardware and software to effect opportunistic collection and analysis of scientific data.

This work was done by Mark James of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to NPO-42513, volume and number of this NASA Tech Briefs issue, and the page number.

Representation-Independent Iteration of Sparse Data Arrays

An approach is defined that describes a method of iterating over massively large arrays containing sparse data using an approach that is implementation independent of how the contents of the sparse arrays are laid out in memory. What is unique and important here is the decoupling of the iteration over the sparse set of array elements from how they are internally represented in memory. This enables this approach to be backward compatible with existing schemes for representing sparse arrays as well as new approaches. What is novel here is a new approach for efficiently iterating over